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Canibalism in Plateau Tiger Salamander (*Ambystoma velasci*) from Presa La Estanzuela, Hidalgo, México.

Intraspecific predation is well known in lizard species (Mitchell, 1986), and in some amphibians (Towsend et al. 1984). These studies have indicated that canibalism is a major factor of mortality of immature individuals in reptiles and amphibians. Although canibalism is well documented in amphibians, nothing is known in the mexican salamander *Ambystoma velasci*. Two specimens (No. ARP-00072 and No. ARP-00074) of this species collected on 30 October and 6 November 2006 at Lake La Estanzuela (20°09′58.9′′, 98°45′24.9′′W [datum: WGS84]; elev. 2739; vegetation type is pine, oak-pine and junipers; Rzedowski, 1978) showed canibalism.

Larger larvae specimens (No. ARP-00072, ARP-00074; 98.7 mm SVL, 6.0 g, 87.0 SVL, 4.6 g, respectively), in captivity, even they had enough food (algae), were feeding on smaller ones (No. ARP-00079, No. ARP-00080; 84.0 SVL, 3.8 g, 76.8 SVL, 3.5 g, respectively). As occur in many amphibians species (Krishna and Vijayalaxmi, 2004) , in *A. velasci*, the risk of canibalism was high on smaller larvae.

Specimens ARP-00072 feeding on ARP-00079, and ARP-00074 on ARP-00080. Predator specimens are housed in the laboratory of Ecología de Poblaciones from Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, México.

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Body Mass and Larvae Size of the Plateau Tiger Salamander (*Ambystoma Velasci*) from Presa La Estanzuela, Hidalgo, México.

Although growth rates are well known in reptiles, it is not very commonly reported in the amphibian group (Duellman and Trueb, 1986). We examined body mass and size of 7 larvae *Ambystoma velasci* captured on 27 October 2006 at Lake La Estanzuela (20°09´58.9´´N, 98°45´24.9´´W [datum: WGS84]; elev. 2739); vegetation type is pine, oak-pine and junipers (Rzedowski, 1978).

Specimens were enclosed in an aquarium (large 60 x 30 wide x 40 height cms), in which we added water at a height of 20 cm and vegetal material (algae) as food (each 6 days) for the larvae. Specimens in captivity were kept at similar temperature (16-20 °C) to their environment.We recorded body mass (nearest 0.1 g) and total body size (TL; snout vent-length plus tail length) to nearest 1 mm with a caliper. Data was recorded each 6 days, except for the last lecture, after 10 days.

Figure 1. *Ambystoma velasci*-Body mass.

Specimens were maintained for 35 days (from 30 October to 4 December) in captivity (Figure 1), and body mass varied during this period (2.4 – 4.3 g; Figure 2; ANOVA, $F_{5,28} = 3.45$, $P < 0.05$, N = 7). Body mass of the individuals increased from 30 October (2.4 g; observation 1, Figure 2) to 6 November (3.3 g; observation 2), from 6 November to 12 November (4.2 g; observation 3), but not from this date to 18 November (3.5 g; observation 4), from this date to 24 November body mass increased to 4.2 g (observation 5), and 4.3 g for 4 December (observation 6). Total body length (TL) varied among period of lectures (62.8 – 84.5 mm; $F_{1,28} = 2.39$, $P < 0.05$; Figure 2). Mean TL at first capture was 62.8 ± 4.1 mm (52.0 – 76.0 mm), 6 November had a TL 73.7 mm (growth rate = 1.82 mm/d; observation 2), 12 November showed a TL of 76.0 mm

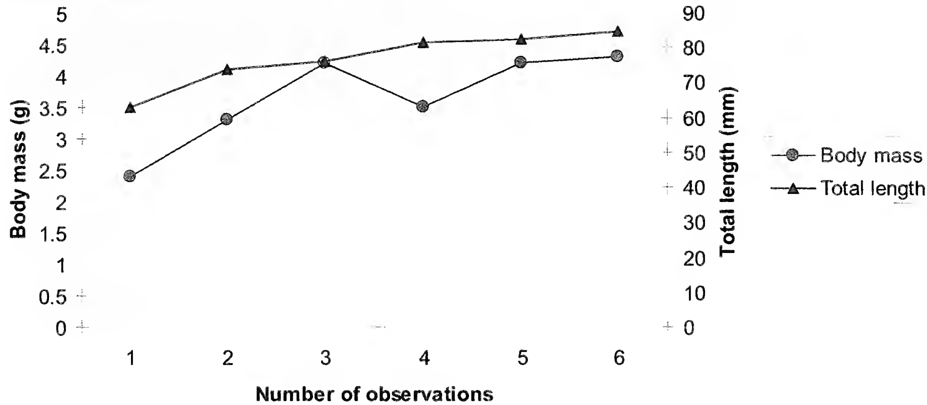

Figure 2. Growth rate of body mass and total length of *Ambystoma velasci* from La Estanzuela,

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(observation 3; 0.38 mm/d), 18 November 81.6 mm (observation 4; 0.93 mm/d), 24 November TL 82.3 mm (observation 5; 0.117 mm/d), and 4 December TL 84.5 mm (observation 6; Figure 2; 0.22 mm/d). Growth rate in *A. velasci* was higher at the begining of the observations than at the end; this pattern is similar to other amphibiasn species (Mitchell and Brown, 2005; Innes et al., 2005).

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Growth and Development Stages in Showy Leopard Frog (*Lithobates spectabilis*) from Presa La Estanzuela, Hidalgo, México.

Growth rate is well known in many anurans species (Duellman and Trueb, 1986), but nothing is known in *Lithobates spectabilis*. On 30 October 2006, one tadpole of *L. spectabilis* (ARP-00037) was collected at Lake La Estanzuela (20°09´58.9´´N, 98°45´24.9´´W [datum: WGS84]; elev. 2739); vegetation type is pine, oak-pine and junipers (Rzedowski, 1978).

The tadpoles were housed in an aquarium (large 60 x 30 wide x 40 height cm,

Figure 1. *L. spectabilis*_Growth and Development Stages.

Figure 1) with water at a height of 20 cm and vegetal material (algae) provided as food (each 6 days). Tadpoles were kept at a temperature (16-20 °C) similar to their natural environment. We recorded body mass (nearest 0.1 g) and total body size (TL: from top snout to caudal fin length) to nearest 1 mm with a caliper (development stages were identified) for 70 days (Gosner, 1960). On 30 October body mass of the tadpole was 4.1g with 83.0 mm TL (observation 1, Figure 2); 6 November was 4.1 g, 71.0 mm (observation 2), 13 November was 6.1 g, 71.0 mm (observation 3), 21 November 5.9 g, 84.4 mm (growth = 1.68 mm/d; observation 4), 30 November 6.6 g, 86.2 mm (0.225 mm/d; observation 5), 4 December 6.5 g, 84.7 mm (observation 6), and 15 January 10.9 g, 98.2 mm (0.321 mm/d; observation 7), respectively. Tadpole was collected at Gosner stage 23 (30 October 2006), and from 21 November 2006 to 15 January 2007, we recorded the stages 29-43. The growth rate and increase in body mass (Figure 2) of *L. spectabilis* is typical of many amphibian species. These data could suggest that adult stage (Gosner stage 46; Duellman and Trueb, 1986) was reached at an age of about four months.

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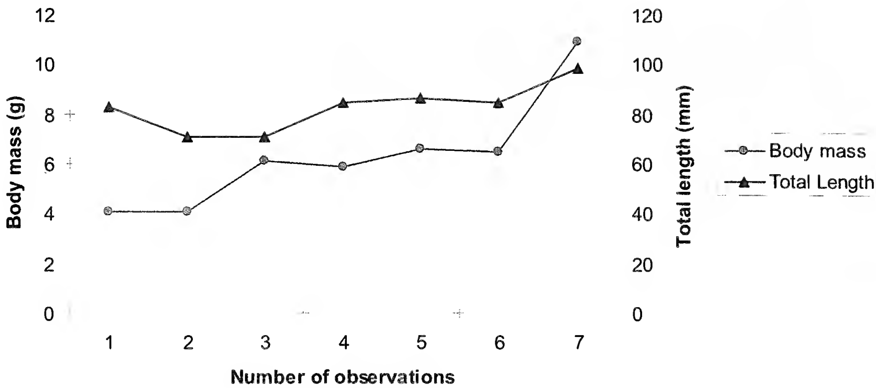

Figure 2. Growth rate of body mass and total length of *Lithobates spectabilis* from La Estanzuela, Hidalgo, México.

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Reproductive Cycles of Three Ameiva Species, *Ameiva festiva*, *Ameiva quadrilineata*, and *Ameiva undulata* (Squamata: Teiidae) From Central America

Stephen R. Goldberg

Abstract

Gonadal materials of *Ameiva festiva, Ameiva quadrilineata* and *Ameiva undulata* from Central America were histologically examined. All of the males examined were undergoing spermiogenesis suggesting that males of these species were capable of year-round breeding. Mean clutch size for 13 *A. festiva* was 2.3 ± 6.48 *SD*. range = 2-3. Mean clutch size for 10 *A. quadrilineata* was 2.20 ± 1.14 *SD*, range = 1-5; five is a new maximum clutch size. Mean clutch size for 12 *A. undulata* was 3.8 ± 1.3 *SD*, range = 2-6. Females with oviductal eggs and concomitant yolk deposition for a subsequent clutch indicates these three species have the potential to produce multiple clutches in the same year.

Introduction

The genus *Ameiva* consists of 34 species distributed in Mexico, Central America, South America and the Caribbean (TIGR Reptile Database, 2008). The purpose of this note is to add information on the reproductive biology of *A. festiva, A. quadrilineata* and *A. undulata* from a histological examination of gonadal material taken from museum specimens. The middle American ameiva, *Ameiva festiva* ranges from Tabasco, Mexico to Colombia from 2-1,200 m (Savage 2002). Information on reproduction in *A. festiva* is in Smith (1968); Fitch (1970, 1973, 1985); Somma and Brooks (1976); Vitt and Zani (1996). The four-lined ameiva, *Ameiva quadrilineata* is known from humid lowlands from extreme southern Nicaragua to western Panama from 0-1,050 m (Savage 2002). Information on reproduction of *A. quadrilineata* is in Hirth (1963), Smith (1968) and Fitch (1970, 1973). The rainbow ameiva, *Ameiva undulata* ranges from Tamualipas and Nayarit, Mexico, south to Nicaragua from 2-1,300 m (Savage 2002). Information on reproduction in *A. undulata* is in Fitch (1970, 1973, 1985) and Savage (2002). Histological evidence is presented that these three species of *Ameiva* produce multiple clutches and undergo continuous spermiogenesis. A new maximum clutch size is reported for *A. quadrilineata*.

Materials and Methods

A total of 67 *A. festiva* including females (n = 18) SVL = 87.7 mm ± 5.6 *SD*, range = 80-100 mm, males (n = 20) SVL = 94.7 mm ± 13.5 *SD*, range = 70-120 mm and subadults (n = 29) SVL = 54.0 mm ± 8.2 *SD*, range = 41-72 mm were examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, CA. Lizards were collected 1953-1979.

A total of 83 *A. quadrilineata* including females (n = 24) (mean snout-vent length, SVL = 65.6 mm ± 7.0 *SD*, range = 53-80 mm), males (n = 36) (mean SVL = 66.9 mm ± 7.3 *SD*, range = 53-82 mm) and subadults (n = 23) (mean SVL = 40.5 mm ± 5.4 *SD*, range = 32-49 mm) were examined. Lizards were collected 1959-1987.

A total of 79 *A. undulata* including females (n = 20) (mean SVL = 81.2 mm ± 6.8 *SD*, range = 70-94 mm), males (n = 39) (mean SVL = 83.2 mm ± 11.5 *SD*, range = 64-108 mm) and subadults (n = 20) (mean SVL = 47.3 mm ± 8.9 *SD*, range = 32-62 mm) were examined. Lizards were collected 1959-1986.

For histological examination, the left testis and epididymis were removed from males and the left ovary was removed from females. Enlarged follicles (> 5 mm length) or oviductal eggs were counted. Tissues were embedded in paraffin and cut into sections at 5 μm. Slides were stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman 1997). Slides of testes were examined to determine the stage of the spermatogenic cycle. Slides of ovaries were examined for the presence of yolk deposition or corpora lutea. Histology slides are deposited in LACM. An unpaired *t*-test was used to compare male and female mean body sizes (SVL) and the relationship between female clutch size and SVL was examined by linear regression analysis using Instat (vers. 3.0b, Graphpad Software, San Diego, CA).

The following *Ameiva* sp. were examined from the herpetology collection of the Natural History Museum of Los Angeles County, (LACM), Los Angeles, California by departments (Colombia, Guatemala, Honduras, Nicaragua) or provinces (Costa Rica).

Ameiva festiva: Costa Rica: Heredia: (n = 4) (LACM 161768-161770, 161773); Limón: (n = 17) (LACM 62046, 131047-131051, 131053-131063); Puntarenas: (n = 2) (LACM 161771, 161772). Colombia: Antioquia; (n = 15) (LACM 44963-44976, 44978); Choco: (n = 12) (LACM 7959, 44980-44986, 72803-72805, 131509). Guatemala: Huehuetenango: (n = 4) (LACM 40410, 40411, 40417, 40419). Honduras: Alantida: (n = 4) (LACM 48072, 48075, 72084, 48085); Cortés: (n = 4) (LACM 48077, 48079, 48080, 48082). Nicaragua: Chuntales: (n = 2) (LACM 74322, 74323); Zelaya: (n = 3) (LACM 14824, 14825, 14841).

Ameiva quadrilineata; Limón: (n = 28) LACM 165950, 165951, 165954, 165955, 165961, 165962, 165967, 165970, 165975, 165981, 165994, 165999, 166003, 166007-166009, 166016, 166018, 166021, 166025, 166028, 166029, 166033, 166034, 166036, 166040, 66041, 166044; Guanacaste: (n = 3) LACM 165953, 166011, 166012; Puntarenas (n = 50): LACM 165950, 165956, 165957, 165959, 165960, 165963-165966, 165971, 165973, 165974, 165976-165980, 165982-165987, 165989-165991, 165993, 165995-165998, 166000-166002, 166005, 166006, 166010, 166013, 166015, 166017, 166020, 166022-166024, 166026, 166027, 166030, 166037, 166038, 166042, 166043; San José (n = 2): LACM 165972, 166019.

Ameiva undulata: Guanacaste: (n = 70) 166046-166052, 166054-166059,166061-166072, 166074-166081, 166083-166091, 166094, 166994, 166996, 166997, 166999, 167000, 167003, 167004, 167006, 167009, 167012, 167013, 167016-167019, 167022, 167025, 167027, 167028, 167030, 167032, 167035, 167038, 167039, 167041-167043; Puntarenas (n = 8): 166993, 166995, 166998, 167002, 167005, 167008, 167021, 167024; San José: (n = 1) 167029.

Results

Males exhibited a testicular cycle in which only one stage, spermiogenesis (= sperm production) was present. In spermiogenesis, the seminiferous tubules are lined by clusters of spermatozoa and metamorphosing spermatids; the epididymides are swollen and contain sperm.

Ameiva festiva: Monthly samples of males undergoing spermiogenesis were: January (n = 1), April (n = 6), May (n = 2), July (n = 2), August (n = 8), October (n = 1). The smallest mature male (spermiogenesis in progress) measured 70 mm SVL (LACM 131053). There was no significant difference between mean clutch values for *A. festiva* females from Costa Rica versus Colombia (t = 0.62, df = 10, P = 0.55). Thus these two data sets and one value from Nicaragua were combined. Linear regression analysis revealed the relationship between clutch size and SVL was not significant (P = 0.35). Monthly changes in the ovarian cycle are in Table 1. Mean clutch size for 13 females was 2.31 ± 0.48 *SD*, range = 2-3. One female (LACM 131051) with two enlarged follicles (> 5 mm) exhibited concomitant early yolk deposition in the same ovary for a subsequent

Month	*n*	Quiescent	Early yolk deposition	Enlarged follicles > 5mm	Oviductal eggs	Corpora lutea
January	1	0	0	0	1	0
April	6	1	2	2	1	0
May	4	0	0	2	2*	0
August	7	1	0	4**	1	1

Table 1. Monthly changes in ovarian cycle of *Ameiva festiva* from Colombia, (n = 8), Costa Rica (n = 9) and Nicaragua (n = 1). * 1 May female with oviductal eggs and concomitant yolk deposition for a subsequent clutch; **1 August female with enlarged preovulatory follicles and concomitant early yolk deposition for a subsequent clutch.

clutch and one female (LACM 161772) with oviductal eggs was undergoing concomitant yolk deposition for a subsequent clutch The smallest reproductively active females measured 82 mm SVL (LACM 44967, 44970) oviductal eggs and (LACM131048) 2 follicles > 5 mm. Subadult *A. festiva* with very small gonads were collected in February (*n* = 1), April (*n* = 12), May (*n* = 2), June (*n* = 1), July (*n* = 4), August (*n* = 9).

Ameiva quadrilineata: Monthly samples of males undergoing spermiogenesis were: January (*n* = 4), February (*n* = 1), May (*n* = 3), June (*n* = 17), July (*n* = 2), August (*n* = 1), September (*n* = 3), October (*n* = 4), November (*n* = 1). The smallest reproductively active male (spermiogenesis in progress) measured 53 mm SVL (LACM 166020).

There was no significant size difference between males and female mean body sizes (unpaired *t* test, *P* = 0.52). Monthly changes in the ovarian cycle are in Table 2. Females with enlarged ovarian follicles (> 5 mm) or oviductal eggs were recorded from April, June, July, September, November. One female from January was undergoing early yolk deposition (marked by the presence of vitellogenic granules) indicating reproductive activity during that month. The smallest reproductively active female (LACM 166030) measured 57 mm SVL and was undergoing early yolk deposition. The correlation between female size (SVL) and clutch size was not significant (linear regression analysis, *P* = 0.095). One female from July (LACM 166043) contained both oviductal eggs and concomitant yolk deposition indicating *A. quadrilineata* may produce multiple egg clutches in the same year. Mean clutch size for 10 females (oviductal eggs or enlarged follicles > 5 mm) was 2.20 ± 1.14 *SD*, range: 1-5. One female with five enlarged ovarian follicles (> 5 mm length, LACM 165963) is a new maximum size clutch record for *A, quadrilineata*. Subadult *A. quadrilineata* with very small gonads were collected in January (*n* = 3), May (*n* = 1), June (*n* = 6), July (*n* = 4), September (*n* = 1), October (*n* = 7), November (*n* = 1).

Ameiva undulata: Monthly samples of males undergoing spermiogenesis were: February (*n* = 1), April (*n* = 6), July (*n* = 8), August (*n* = 17), September (*n* = 4), October (*n* = 2). The smallest mature male (spermiogenesis in progress) measured 65 mm SVL (LACM 166086). Monthly changes in the ovarian cycle are in Table 3. Mean clutch size for 12 females was 3.8 ± 1.3 *SD*, range = 2-6. There was a significant positive relationship between female SVL and egg number: (*n* = 12, *P* = 0.002, *r* = 0.79, Y = -8.79 + 0.15X). Reproductively active females were found in the four months sampled: June to August. The presence of one July female with oviductal eggs and concomitant yolk deposition and the presence of one June female and one September female with corpora lutea from previous clutches and early yolk deposition for subsequent clutches indicates *A. undulata* may produce multiple clutches in the same year. The smallest reproductively active

females (LACM 166047, enlarged follicles > 5 mm) and (LACM 166078, early yolk deposition) measured 70 mm SVL. Subadult *A. undulata* with very small gonads were collected in January (*n* = 1), February (*n* = 6), April (*n* = 10), July (*n* = 2), October (*n* = 1).

Discussion

Considering the single stage (spermiogenesis) in the testicular cycles of *Ameiva* reported herein, two other stages: regression (non-reproductive) and recrudescence (recovery) which are typically seen in seasonally breeding lizards from temperate areas were absent (see for example, Goldberg 2005). Continuous spermiogenesis has been reported for other lizards from Costa Rica: the microteiids *Leposoma southi* and *Ptychoglossus plicatus* (Goldberg 2008a) and the gecko *Lepidoblepharis xanthostigma* (Goldberg 2008b). However, in contrast *Sceloporus malachiticus* from high elevations in Costa Rica (2400-3000 m) exhibited decreasing testicular activity in October-December followed by a distinct period of regression in January (Marion and Sexton, 1971). The presence of males undergoing spermiogenesis in the following months: *A. festiva* (January, April, May, July August); *A. quadrilineata* (January, February, May, June, July, August, September, October, November) and *A. undulata* (February, April, July, August, September, October) suggests sperm production is continuous for these species.

Smith (1968) reported a mean clutch size of 2.3 for *A. festiva* from Limón Province, Costa Rica and minimum size for maturity of 74 mm SVL in males and 77 mm SVL in females. Fitch (1970)

Month	*n*	Quiescent	Early yolk deposition	Enlarged follicles > 5mm	Oviductal eggs
January	1	0	1	0	0
April	1	0	0	1	0
June	10	3	2	1	4
July	3	0	1	1	1*
September	4	3	0	1	0
October	4	1	2	0	1
November	1	1	0	0	0

Table 2. Monthly changes in ovarian cycle of *Ameiva quadrilineata* from Costa Rica. *1 July female contained oviductal eggs and concomitant yolk deposition for a subsequent clutch.

Month	*n*	Quiescent	Early yolk deposition	Enlarged follicles > 5mm	Oviductal eggs
June	2	1	1*	0	0
July	13	1	1	7	4**
August	4	1	2	1	0
September	1	0	1*	0	0

Table 3. Monthly changes in ovarian cycle of *Ameiva undulata* from Costa Rica. * one June female and one September female each contained corpora lutea from a previous clutch and concomitant yolk deposition for a subsequent clutch; ** one July female contained oviductal eggs and concomitant yolk deposition for a subsequent clutch.

reported gravid *A. festiva* from Costa Rica that were collected March, July, August and September. It appears that in Costa Rica, *A. festiva* from more seasonal climates have larger egg clutches (3.0) than those from aseasonal climates (2.2) (Fitch 1985). Vitt and Zani (1996) reported that *A. festiva* females from Nicaragua produced a mean clutch size of 3.5 ± 0.3 SE, range 2-5.

Smith (1968) reported that in Limón Province, Costa Rica, *A. quadrilineata* males and females were reproductively active throughout the year with a mean clutch size of 2.0. Minimum size for reproductive activity in females was 64 mm SVL and 59 mm SVL in males (Smith, 1968). Hirth (1963) reported the smallest *A. quadrilineata* male in breeding condition measured 58 mm SVL and females as small as 48 mm SVL contained oviductal eggs; the largest clutch produced consisted of 4 eggs.

In the Yucatan Peninsula, Mexico, *A. undulata* presumably breeds in summer and fall (Fitch 1970). Clutch sizes of *A. undulata* were higher in the Yucatan, Mexico (range = 2-7) than in Nicaragua and Costa Rica (range = 1-5) suggesting the possibility of geographic variation in reproduction.

My finding of females of *A. festiva, A. quadrilineata* and *A. undulata* with oviductal eggs and concomitant vitellogenesis (yolk deposition) for a subsequent clutch indicates the potential for producing multiple clutches in the same year. The collection of subadults of the above three species from most of the year likely reflects extended reproductive cycles in which hatchlings emerge at different times. Similarly, Smith (1968) recorded hatchlings of *A. festiva* and *A. quadrilineata* from all twelve months of the year.

It appears several species of *Ameiva* have extended reproductive cycles and are capable of reproducing throughout the year (León and Ruiz 1971; Somma and Brooks, 1976; Vitt, 1982). However, reproduction is seasonal in other species (Simmons 1975; Magnusson 1987, Rodriguez-Ramirez and Lewis 1991, Censky 1995). Furthermore, it seems reproduction may be both seasonal and aseasonal in the same species depending on the yearly distribution of rainfall (Colli 1991). In species of *Ameiva* occupying extensive geographic ranges, examination of samples from different parts of their ranges are needed to ascertain geographic variations in reproduction. Clearly, much work remains to be done before the diversity of reproductive cycles in lizards comprising the genus *Ameiva* can be ascertained.

Acknowledgments

I thank Christine Thacker (LACM) for permission to examine lizards which are part of the Costa Rica Expeditions Collection donated by Jay M. Savage to LACM in 1998.

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The Past History of Documenting the Distributions of Amphibians and Reptiles of Maryland and the District of Columbia

Prior to the early1940's distributional patterns of Maryland's amphibians and reptiles were not readily understood. In 1936, the Natural History Society of Maryland published Snakes of Maryland by Kelly, Davis and Robertson. The distributional data on all Maryland reptiles was later published by McCauley in 1945. Romeo Mansuetti worked hand and hand with McCauley plotting distributions of Maryland's reptiles at the NHSM. McCauley used Maryland outline maps with dots representing specific localities to show distribution... an important step in our understanding the natural distribution of Maryland's reptiles. Within the next decade or so, the Handbook series, Snakes, Wright and Wright (1957), Lizards, Smith (1946), Turtles, Carr (1952), Frogs and Toads, Wright and Wright (1949), Salamanders, Bishop (1943), and the popular Reptiles and Amphibians by Zim and Smith (1953) became available. The handbook series had maps where the general North American distributional patterns could be determined with some accuracy. The most readily available was the pocket book by Zim and Smith which used maps of the United States that were very small, and one could only guess if the area in question was meant to be included at the extremity of the distribution. Conant (1958) published his first Field Guide, A Field Guide to Reptiles and Amphibians, and the distribution maps he presented represented the first major attempt to carefully document the ranges of all eastern North American species. Essentially all his subsequent work on the field guide, on the distribution of amphibians and reptiles in Maryland, has been the result of sharing and publication of distribution records by members of the NHSM.

In 1960, Cooper published the Distributional Survey V of Maryland and the District of Columbia. In this paper there were tables showing the known distribution of the amphibians and reptiles of Maryland and the District of Columbia by County and also a table showing the known distribution in Maryland's Physiogeographic Provinces. This was the first published list of Maryland amphibians. John E. Cooper at this time was Curator, Department of Herpetology, NHSM. Harris (1965) republished Cooper's (1960) survey, bringing it up to date. In 1969, Harris published the first distributional survey complete with maps of every amphibian and reptile known in Maryland. The maps were based on those McCauley (1945) used for the reptiles but updated, and distribution maps for the amphibians were presented for the first time. This publication was revised, updated and again published in 1975 (Harris). Starting with the second edition of Conant's, A Field Guide to Reptiles and Amphibians of Eastern and Central North America (1975), and all subsequent editions the map revisions, depicting species' ranges in Maryland, were the result of records we provided. We reviewed the maps, for Conant, prior to publication.

It was members of the NHSM that conducted the first Bog Turtle surveys in the 1960's and determined the turtle's range within the state. It was also the NHSM that provided the first list of endangered amphibians and reptiles and submitted the list to Maryland Department of Natural Resources for inclusion in the newly created Maryland Endangered Species Act (1971). Our list was unconditionally accepted and became effective October 12, 1972. The list was published as Endangered Amphibians and Reptiles of Maryland: A Special Report (1973).

A great number of people who were NHSM members have provided distribution data, published records in the NHSM Junior Society News, Bulletin of the Natural History Society of Maryland, The Maryland Naturalist, Maryland, Proceedings of the Natural History Society of Maryland, and the Bulletin of the Maryland Herpetological Society, and News and Views. (All of these journals were published by the Natural History Society of Maryland.) These include, but not limited to C.B. Brimley, J.A. Bures, R. Buxbaum, H.W. Campbell, D. Carver, E. Cohen, R. Conant,

J.E. Cooper, A.W Davis, H.T. Davis, H.C. Eichhorn, J.A. Fowler, L.R Franz. Jr., S. Graham, W.L. Grogan, Jr., F. Groves, J. D. Groves, R.A. Hahn, H.A. Hanzley, J.D. Hardy, Jr., H.S. Harris, Jr., P. Hertil, H.F. Howden, T. Keefer, H.A. Kelly, G.C. Klingel, D. Kramer, L. Lamay, J. Leake, D.S. Lee, D.J. Lyons, B. Manns, R. Mansuetti, W. Marchant, A.G. Marsiglla, D. Marvel, B. Marvel, R. McCauley, W.H. McClellan, R.W. Miller, K.T. Nemuras, A. Nichols, A. Norden, J.E. Norman, W. Norman, E. Palmer, C.R. Posey, C.E. Prince, L.A. Putens, R. Quinn, S. Rae, C.F. Reed, M. Reid, H.C. Robertson, J.F. Schrelger, Jr., R.S. Simmons, C.J. Stine, D. Stout, R.G. Tuck, Jr., H.E. Volks, C.E. Wagner, K. Wells, P. Wemple, J. Wheeler, F.R. Williams. The majority of the more interesting records were published by many of these same people in the Bulletin of the Maryland Herpetological Society.

The NHSM houses the largest collection of Maryland amphibians and reptiles available for scientific study. Catalogue numbers are in the high thousands. The collection is in two sections, the original NHSM collection and the donated HSH collection.

Today, 2008, the distributional survey by Harris (1975) represents what we now consider the historical Distribution of Maryland's amphibians and reptiles. A new outline map will be created with all current records plotted to reflect the species present distributions in an attempt to illustrate changes resulting from development and other detrimental factors. .

It is our plan to create an up to date distributional survey of Maryland's amphibians and reptiles to be available both as a web site and eventually a hard copy that can be used by the public, State and researcher's as well. The web site will benefit from the ability to be modified, as new data becomes available. The site will contain photographs of adult amphibians and reptiles, and life history photographs as warranted, both historical and current distribution maps and where necessary additional information concerning conservation issues, and selected written commentary. We may publish individual accounts, as they are prepared in the News & Notes section of the Bulletin of the Maryland Herpetological Society, as this will likely generate additional regional records and reports. The Bulletin was started in 1965 and is currently on Volume 44. We see this entire program as a natural continuation of a program started in the 1930's by NHSM members. At this time we have over 30 regional herpetologists, most of who are members of the Society, willing to participate in this effort. A number of these contributors had extensive experience with specific species in the late 50's and 60's and they will be able to provide information about the current relative abundance of our various reptiles and amphibians.

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Reproduction in the Blackbelly Racerunner, *Aspidoscelis deppei* (Squamata: Teiidae) from Costa Rica

Stephen R. Goldberg

Abstract

Information on the reproductive cycle of *Aspidoscelis deppei* from Costa Rica is presented from a histological examination of gonadal material. *Aspidoscelis deppei* exhibits an extended reproductive cycle with males undergoing spermiogenesis in all months sampled: February, April, June, July and August. Reproductively active females were recorded from all months examined: February, April, July and August. Mean clutch size for 12 gravid females was 2.4 ± 0.67 SD, range = 2-4. The presence of corpora lutea and concomitant early yolk deposition in one female indicates *A. deppei* may produce multiple clutches. Minimum size for reproductive activity was 54 mm for males and 58 mm for females.

Introduction

Aspidoscelis (as *Cnemidophorus*) *deppei* is known from Veracruz and Michoacán, México, Guatemala, Belize, Honduras, Nicaragua to central Costa Rica (Savage 2002). Information on reproduction of *A. deppei* in Costa Rica is in Fitch (1970, 1973a, b). Other information regarding reproduction in *A. deppei* is in Fitch (1985) and Vitt et al. (1993). The purpose of this paper is to provide additional information on reproduction of *A. deppei* from a histological examination of gonadal material. The first histological information on the testicular cycle and evidence that *A. deppei* produces multiple clutches is presented. Minimum sizes for reproductive activity in males and females are given.

Methods

Thirty-six adult male *A. deppei* (mean snout-vent length, SVL = 72.9 mm ± 5.7 SD, range = 54-84 mm) and twenty-two adult female *A. deppei* (mean SVL = 66.6 mm ± 5.2 SD, range = 58-79 mm) from Costa Rica deposited in the Natural History Museum of Los Angeles County (LACM), Los Angeles, California were examined. Lizards were collected 1959 to 1973.

Aspidoscelis deppei examined by Costa Rica province are:

Alajuela: LACM 165442; Guanacaste: LACM 165437, 165438-165441, 165445, 165447, 165448, 165450, 165453-165460, 165462, 165463, 165465, 165466, 165468- 165472, 165474, 165475, 165477, 165478, 165481, 165482, 165484, 165486, 165487, 165489, 165490, 165492, 165493, 165495-165497, 165500, 165502, 165507, 165510; Puntarenas: 165443, 165449, 165452, 165464, 165480, 165483, 165485, 165488, 165501, 165504, 165505.

A mid-ventral incision was made in the lower portion of the abdomen and one testis or ovary was removed for histological examination. Slides were prepared by conventional methods and stained with hematoxylin and eosin (Presnell and Schreibman, 1997). Enlarged follicles > 5 mm were counted. Testis slides were examined to determine the stage of the testicular cycle. Ovary slides were examined for the presence of vitellogenesis (= yolk deposition) or corpora lutea. Histological slides were deposited in LACM. Comparisons were made between male and female mean body sizes (SVL) using an unpaired *t* test; the relation between female SVL and clutch size was examined by linear regression analysis (Instat, vers 3.0b, Graphpad Software, San Diego, CA).

Results

Testicular cycle: Males were significantly larger than females (unpaired t-test, $t = 4.2$, $df = 56$, $P = < 0.0001$). The only stage observed was spermiogenesis in which the seminiferous tubules were lined by masses of spermatozoa or metamorphosing spermatids. Other stages (regression and recrudescence) which are typical of temperate zone lizards with seasonal reproductive cycles (see for example, Goldberg, 2005) were not observed. Months examined followed by sample sizes were: February ($n = 5$), April ($n = 4$), June ($n = 1$), July ($n = 21$), August ($n = 5$). The smallest reproductively active male examined (LACM 165481) was from April and measured 54 mm SVL. Spermiogenesis was beginning as small clusters of spermatozoa were observed. Spermatozoa were more abundant in larger males.

Ovarian cycle: Monthly stages in the ovarian cycle are in Table 1. Reproductively active females were recorded in February, April, July and August. The presence of one August female (LACM 165500) that was undergoing early yolk deposition for a subsequent clutch while containing corpora lutea from a previous clutch is evidence that *A. deppei* can produce multiple egg clutches in the same year. The smallest reproductively active female (LACM 165474) measured 58 mm SVL and was from April. Mean clutch size for 12 females was 2.4 ± 0.67 SD, range = 2-4 eggs. Linear regression analysis showed the correlation between female size and clutch size was not significant ($P = 0.148$).

Table 1. Monthly stages in the ovarian cycle of 22 *Aspidoscelis deppei* from Costa Rica.

Month	***n***	**No yolk production**	**Early yolk deposition**	**Enlarged follicles > 5mm**	**Oviductal eggs**
February	2	0	0	2	0
April	3	1	1	1	0
July	13	2	5	4	2
August	4	0	1*	3	0

*One August female was undergoing yolk deposition for a subsequent clutch and also contained corpora lutea from a previous clutch.

Discussion

Fitch (1973a,b) reported differences in reproduction of *A. deppei* (as *Cnemidophorus deppii*) in two populations from Costa Rica. The breeding season appeared restricted at Playas del Coco, Guanacaste Province with little egg laying during the dry season (December to April). In contrast, there was only slight reduction in reproduction during the dry season at Boca de Barranca, Puntarenas Province. In the current study, most *A. deppei* females (81%) were from Guanacaste Province. One of these Guanacaste females females from February contained three enlarged follicles (> 5 mm) and two from April, contained two enlarged follicles (> 5 mm) and early yolk deposition, respectively indicating reproductive activity occurs during the dry season.

Vitt et al. (1993) studied *A. deppei* (as *Cnemidophorus deppii*) during March in Rivas Department, Nicaragua. As was the case in Costa Rica, there was no significant relationship between female SVL and clutch size Mean clutch size for 17 females was 1.8 ± 0.2 SE, range = 1-2. Enlarged follicles and corpora lutea were seen in four females indicating production of multiple clutches (Vitt et al. 1993).

Fitch (1985) compared mean clutch sizes between northern populations from Mexico 2.7 ± 0.2 (2-4) and southern from Nicaragua and Costa Rica 3.0 ± 0.3 (1-4). He reported reduced egg production in the south due to the long dry season (Fitch, 1985).

Conclusion

My data indicate that in Costa Rica *A. deppei* has a prolonged reproductive season with males producing sperm during all months examined. Males commence reproduction at 54 mm SVL. Females commence reproduction at 58 mm SVL. Histological evidence is given that females may produce multiple clutches in the same year.

Extended reproductive cycles have been reported for other lizards from Costa Rica (Smith, 1968, Goldberg, 2008a,b,c). In contrast, *Sceloporus malachiticus* which occurs at high elevations in Costa Rica exhibits a seasonal reproductive cycle similar to temperate zone lizards (Marion and Sexton, 1971). Subsequent studies on reproduction in other lizards from Costa Rica are needed before the diversity of reproductive cycles exhibited by these lizards can be ascertained.

I thank Christine Thacker (LACM) for permission to examine specimens which are part of the CRE (= Costa Rica Expeditions) collection donated to LACM by Jay Savage.

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News and Notes:

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